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ABSTRACT

In an era of spiraling costs, librarians must carefully assess literature use among their patron groups when making decisions on selection, deselection, and storage of journals. A citation analysis was conducted using a group of 52 papers submitted by research physicians at the Summa Health System (Akron, Ohio) for a research award competition during the years from 1993 to 1995. The study investigates the use ratio of journals to books, the age of the journal articles, the country of publication and the language of the cited journal articles, and the citation patterns of the residents in regard to use of general journals, specialty journals in their own field, or specialty journals in other fields. Out of 869 citations, 91.3% of them referred to journal articles, with 252 separate journal titles represented. While only 43.1% of the journal articles were published since 1990, 69% of the books were in this category. Most of the journals, 82.1%, were published in the United States and 11.3% were published in England. All but two articles were written in English. General medical journals were cited 11.7% of the time, specialty journals in the resident's own field 31.9% of the time, and journals in other specialties 54.5% of the time. Of the cited journals, 30% of them appeared on consulted lists of core medical subscription recommendations, and 43% of them were carried by the Summa libraries. Six tables accompany the data, and four appendices provide lists of cited journals and citation count worksheets. (Contains 55 references.) (BEW)

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ED 390 418

Journal Use by Hospital Resident Physicians in a Research Paper Competition: A Citation Analysis

A Master's Research Paper submitted to the
Kent State University School of Library and Information Science
in partial fulfillment of the requirements
for the degree Master of Library Science

by

Roberta Shorter

December 1995

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ABSTRACT

In this time of spiraling costs, it is particularly important for librarians to carefully assess the literature uses and needs of their particular patron groups when making decisions on selection, deselection and storage of journals. Several types of use studies have been conducted in libraries to aid in these decisions.

A citation analysis was conducted using a group of fifty-two papers submitted by resident physicians at Summa Health System for a research award paper competition for the years 1993-1995. The study was designed to determine the use ratio of journals to books, the age of the literature cited, the country of publication and language of the cited journal articles, and the citation patterns of residents in regard to their use of general medical journals, specialty journals in their own field of medicine, and specialty journals in other medical fields.

There were 869 citations, with 91.3% of them referring to journal articles and 6.7% to books. A total of 252 journal titles were cited. The journal articles cited tended to be older than the cited books. While 43.1% of the journal articles were five years old or newer, 69% of the books were in this category. Most of the journals cited, 82.1%, were published in the United States, with 11.3% published in England. All but two of the cited articles were written in English. General medical journals were cited in 11.7% of references. The authors of the papers cited journals in their own specialty in 31.9% of the citations, and in other specialties in 54.5% of the citations.

The list of journals cited by this group of resident physicians was compared to two well-known lists of core medical journals for small and medium-sized medical libraries, and to the current subscription list of the Summa libraries. The *Abridged Index Medicus List of Journals Indexed* and the Brandon/Hill list each include about 30% of the cited titles, while 43% of the titles are on the current subscription list of the libraries.

The study highlights the value of local studies, and the need to study the literature used for a variety of purposes by the many patron groups served by a library.

Master's Research Paper by

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I. INTRODUCTION

One of the purposes of a hospital medical library is to provide a collection of books, journals and other reference sources which will meet the basic information needs of the various groups which make up the library's patrons. Ever-expanding networks and consortia, in combination with modern technology, have made it possible to locate and borrow books from other libraries or obtain photocopies or faxes of articles through interlibrary loan. A limited number of journals are available online in full-text versions, but the much discussed "library without walls" is not yet a reality, and is not likely to be in the near future. Until such time as a multitude of problems have been solved involving copyright, ownership of information, and, more basically, who will fund and manage "instant access," it is still important that the local hospital or medical center library make readily available at least a core collection of the most frequently needed materials for library patrons.

The spiraling prices of library materials, and particularly of journal subscriptions, have strained library budgets and forced librarians to look critically at subscription lists to determine which journals are used often enough by the library's various patron groups to justify subscriptions and which are needed so infrequently that they may be more economically obtained by other means. Library space is also at a premium and expanding periodical collections can quickly fill available shelves. Decisions need to made about the value of keeping long runs of journals in the library as opposed to disposing of older journals or sending them to remote storage areas.

Lists of standard or core journals are available to help medical librarians select those that will be most useful for their patrons. Two of

the most commonly consulted are the Brandon/Hill *Selected List of Books and Journals for the Small Medical Library* (Brandon and Hill 1995) and the *Abridged Index Medicus List of Journals Indexed* (National Library of Medicine 1994).

The Brandon/Hill list, according to its authors, has been used since its inception in 1965 as a tool for developing or updating libraries in hospitals. The primary focus is patient care, rather than research. Basic science journals are not included on the list, on the theory that their low use would not justify their cost, and needed articles could be more economically obtained elsewhere (Brandon and Hill 1995).

The introduction to the *Index Medicus* list describes *AIM* (*Abridged Index Medicus*) as a subset of the National Library of Medicine's MEDLARS database of medical literature. *AIM* contains citations to biomedical literature judged to be of immediate interest to practicing physicians, covering all clinical fields (National Library of Medicine 1994). A help screen for MEDLINE, the NLM online database, suggests that limiting a search to *AIM* journals "is a good way to limit retrieval to journals commonly found in hospital and medical library collections" (National Library of Medicine 1995).

As useful as lists of standard and core journals are to medical librarians in selecting journals for their libraries, additional information is needed. Judgments about which new journals to buy, which current subscriptions to continue, where to keep older journals, or whether to keep them at all, are best made when there is accurate information available about the various groups the library serves and the nature of their particular needs and patterns of use.

Several types of studies are employed in libraries to measure the use of resources. Circulation statistics are compiled to see which materials or which types of materials are checked out. Interlibrary loan requests may be tabulated and analyzed to learn what types of materials, and, in the case of journals, which titles are borrowed the most frequently. In-house use of library materials may also be measured. Libraries which provide photocopying service can count photocopy requests. In reshelving studies, patrons are asked not to reshelve items they use in the library, and a count is made by library staff before books and journals are reshelved. Patron self-reporting studies ask patrons to fill out a questionnaire or initial or check a slip of paper attached to unbound or bound journals to indicate their use of an item. Library staff may use direct observation techniques and record their impressions of materials used and the types of use.

Another technique used to measure journal use, the one used in this study, is citation analysis. Indexes, subject bibliographies, or core journals or texts in a field may be analyzed to see which sources are cited. The citation indexes, and particularly their machine-readable electronic databases, may be searched to learn which journals or authors have been cited. These products, *Science Citation Index*, *Social Science Citation Index*, and *Arts and Humanities Citation Index*, all created by the Institute for Scientific Information, make it possible to search huge databases of citation information and to analyze complex relationships between citing and cited papers.

Local use studies may also use citation analysis. The papers of a particular group of researchers or students may be obtained, and the citations in them analyzed to determine the formats or titles most often

used. Local use citation studies reported in the library literature have most often involved researchers in university libraries. One reason for the concentration of citation studies in academic libraries may be the high volume of publication by university researchers, and also the fact that their publications are likely to be covered in the standard indexing tools. The faculty status of many librarians in academic settings, the requirement that they conduct and publish research, and the time allowed for them to pursue these activities probably also contribute to the volume of research involving academic libraries.

There are fewer reports on the use of literature in medical libraries. Most of them involve reshelving or user self-reporting studies. The staffs of larger hospitals, particularly teaching hospitals with residency programs, usually include researchers who have published papers, but citation analyses of their publications have not been reported. This author found one master's research paper which analyzed citations in the publications of researchers at a medical school and compared them to the library's holdings (Hanrahan 1994).

The literature use of hospital residents as a group appears not to have been studied by citation analysis. A major reason for this is probably that hospital residents usually do not publish papers in significant numbers, nor are other papers they have written readily available, and it is therefore difficult to obtain citations to analyze. An active research program at Summa Health System, however, supports and encourages residents in research projects. Papers are submitted for an annual research award paper competition and are collected by the Research Department.

Purpose of the Study

The purpose of this study was to determine various characteristics of the literature used by one group of hospital library patrons, residents, for one particular purpose, the writing of research papers for a competition.

Hypothesis

It was hypothesized that the study would show that these residents used a high percentage of journals as opposed to books, in accordance with the usual use patterns of researchers in the hard sciences. It was also expected that a relatively small number of journal titles would account for a large percentage of the citations with the remaining citations scattered over a larger number of titles, and that a higher percentage of citations would be to more recent literature, probably within the previous five years. A fairly high degree of conformity to the journal titles in the *AIM* and Brandon/Hill lists was also predicted.

It was hoped that this research would provide useful information about this facet of library use that could be combined with other kinds of library use data to aid in the determination of a core group of journals tailored to the needs of this particular library community.

Definition of Terms

The following definitions were used in this study:

Citation: A bibliographic reference to a work. Items in footnotes, endnotes, bibliographies and reference lists were included. Works referred to in the text of a paper but not included in one of the above formats were not counted. Each cited title or article was

counted only once per paper. References made as "Op. cit." or "Ibid" were not counted.

Book: Textbooks, handbooks and other individual monographs which are not part of a series were included here.

Journal: Serial publications which are printed on a regular basis, such as monthly, quarterly, or annually. The terms journal and periodical are used interchangeably. Hardbound annual publications which are issued as a series, for example *Annual Review of Medicine* are also included here.

Conference report: An individually published report of a conference or meeting. Reports of meetings which were published as an article in a journal are included with journals.

General Medical Journal, specialty medical journal: Subject categories of journals in *Index Medicus List of Journals Indexed* were used. For subject identification of journals not indexed in *Index Medicus*, *Medical and Health Care Books and Serials in Print* was used.

II. REVIEW OF THE LITERATURE

In the current climate of static or reduced library funding and spiraling costs, librarians need data on the information use of various patron groups in order to wisely apportion limited library acquisition budgets. This need for reliable data regarding the use of various types of information sources, and particularly the use of serials by students, faculty and researchers in academic and special libraries, has prompted numerous studies and papers on ways to measure patron use of these resources.

Studies have shown that researchers in different fields use literature differently. Devin reviewed more than fifty studies on the monograph/serial citation ratios for researchers in different subject areas and found that researchers in the hard sciences use a higher percentage of serials than those in the humanities and social sciences. The percentage of serials used was 19.9% for researchers in English literature, 27.1% for historians, 38.8% for sociologists, 85.2% for researchers in medicine and 93.6% for chemists. Devin suggests that librarians should consider the appropriate monograph/serial ratio for each discipline represented in the collection to determine the appropriate ratios of expenditures (Devin 1989).

Use Studies in Libraries

There are many ways to conduct use studies in libraries. Circulation statistics may be compiled quite easily, especially with automated circulation systems, but serials do not circulate in many libraries, so other methods are needed to determine usage of serials. Common techniques include gathering statistics on photocopying or

interlibrary loan requests, counting periodicals reshelved by library staff, collecting user self-reporting data and direct observation of library patrons.

A self-reporting study done in the Science and Engineering Library at the University of Buffalo compared results with a reshelving study done four years earlier. The self-reporting study indicated a 40% drop in usage of current periodicals which were reported as heavily used in the earlier study. The researcher suggests possible explanations for this apparent drop in use, and points out advantages and disadvantages of the two methods. The self-reporting method is relatively inexpensive to carry out. Forms are attached to journals, and users are asked to initial the form with each use. There are, however, disadvantages which can lead to inaccurate results. Users may be tempted to manipulate the data by over-reporting usage of favorite journals. Others may ignore the study. Any level of use, from picking up a periodical and scanning the table of contents to reading several articles has the same weight. Reshelving studies are more expensive to conduct, and require more staff time because volumes must be reshelved frequently to avoid uncounted multiple uses. The technique is less vulnerable to deliberate manipulation by users, but users sometimes reshelve journals, leading to under-reporting (Naylor 1994).

Direct observation is another way of measuring periodical use. Researchers in the Evans library at Texas A & M University saw this method as a way of avoiding the dependence on user participation and cooperation involved in user self-reporting studies, and on staff efficiency in reshelving studies. While direct observation is better suited to identifying types of use (whether a journal is scanned or actually read,

for example), problems arise with observational errors, the difficulty in collecting data regarding specific titles, high costs for staff time, and the possible interference effects of this more intrusive method (Bustion, Eltinge and Harer 1992).

Citation Analysis

Various types of citation analysis, the method employed in this research study, are also used to measure serial use. Citation analysis, which was used as early as 1917 as "statistical bibliography" (Subramanyam 1980), involves collecting and analyzing data on references from indexes and subject bibliographies, footnotes, reference lists and bibliographies of published or unpublished works. These studies are used in many ways. Library serials collections are developed or evaluated through the use of core or ranked lists of most-used journals. Sociological and historical analyses are made of the use of literature in various fields. Journals in a field are ranked on the basis of their importance or impact. For example, one researcher analyzed library science journals to determine which journals were the most prestigious for publications by health sciences librarians, and would therefore be of the most value to those seeking tenure and promotion (Fang 1989).

The influence or prestige of individual scholars or institutions may be affected by where they publish or are cited. Controversy can arise, especially when ranking on this basis is done formally, as in the publication *Science Watch* (Taubes 1993).

Citation studies may range from simple counts of citations for a given document or set of documents, to "impact rankings" of journals which allow comparisons of journals publishing widely varying numbers

of articles. Linda Smith describes these methods, and also discusses more complex techniques involving "bibliographic coupling" (where the reference lists of two documents cite the same document or documents), and "co-citation analysis" (where two documents are jointly cited in the same subsequent document) (Linda Smith 1981).

Science Citation Index created by the Institute for Scientific Information in 1964, followed by *Social Science Citation Index* and *Arts and Humanities Citation Index*, provide an immense database of citation data. In machine-readable form, these databases allow for the speedy collection and manipulation of data and have increased the ease and popularity of citation studies.

Bibliometric Laws

Some patterns or principles have been observed in citation analysis. Subramanyam, in a discussion of the history of citation analysis, discusses Bradford's law of scattering which describes a pattern in which a small core of journals in any field contains a large proportion of the significant articles, and the rest of the articles are scattered throughout a larger number of journals (Subramanyam 1980). This phenomenon is also known as dispersion or productivity (Wallace 1987). This concept has also been referred to as the "80/20" rule, which states that 20% of the collection meets 80% of user needs (Burnham, Shearer and Wall 1992).

Another phenomenon often studied in citation analysis is the aging or obsolescence of the literature. A very high percentage of use is reported for recent articles, while use of older items drops off quickly (Wallace 1987). Other authors report that citations to a particular

document will peak in the second or third year after publication. Similarly, the largest number of references made in particular sources are to documents published two or three years earlier (White and McCain 1989). Researchers have also found that the literature of different fields ages or becomes obsolete at different rates, with earlier obsolescence for articles in medical and chemistry journals, for example, compared to that for articles in social science journals (Glanzel and Schoepflin 1995).

Sources of Citations for Analysis

Citations for analysis may be obtained from several sources. There are advantages and disadvantages for each type of source, and the resulting data can be used in different ways. Secondary sources such as indexing and abstracting journals are easily accessible, and counting their citations is a fairly mechanical process, but indexing services vary in their coverage, both of journals and over time. Some journals may be covered completely and others selectively. There is also usually a language or country bias. National bibliographies give a total picture of the monographs of a country, but there is no selectivity or assessment of quality, and serials are not covered. Subject bibliographies usually indicate a measure of quality, but go out of date quickly and are generally restricted to monographs (Brittain and Line 1973).

Primary publications and the citations in them are the most common source for citation studies. Advantages of using primary sources are that the most cited items may be assumed to be those most wanted by library users. There is also some implicit indication of quality. Analyses may be made by subject and language, and obsolescence patterns may be observed. Primary sources also have disadvantages.

Researchers may not cite all of the sources they use, or conversely, use all of the sources they cite. Authors publishing in a journal are more likely to cite other articles from that same journal rather than those from other journals. In addition, journals which are readily available to a writer are more likely to be cited than those which require more time and effort to obtain. Researchers should be aware of the particular limitations of various types of citation data and choose sources appropriate for their needs (Brittain and Line 1973).

Citation Analysis in Academic Libraries

Many studies involving citation analysis have been reported in the library literature, but few of them have dealt with medical literature. A majority of citation analyses involve local use in academic or research libraries, and generally usage by faculty or other researchers.

Studies in the applied physical sciences at the Georgia Institute of Technology (Dykeman 1994) and in forestry at the University of Florida, Gainesville (Haas and Lee 1991) analyzed citations in the publications of faculty and compared them to the institutions' library holdings. A study of citations by faculty in the Physics Department at Emory University emphasizes a technique in which citations were downloaded from *SciSearch* on DIALOG, edited using a word processing program and analyzed using a spreadsheet program (Greene 1993). A study of journal use by the Biology Department at Temple University analyzed citation data from faculty publications, doctoral dissertations and preliminary doctoral qualifying briefs. This study points up the importance of studying use patterns of different patron groups to get a more complete profile of journal use (McCain and Bobick 1981).

Citations made in publications of researchers at Battelle, an international contract research and development organization, are analyzed in a master's research paper. Core lists of journals for the organization and for the disciplines represented are presented, and the unique problems of collection development for a special library which serves researchers in a non-university organization are discussed (Blum 1993).

Some citation analyses have been conducted in academic settings using citations from student papers. A study at a Texas university analyzed journal use by graduate students in psychology, using the citations in their theses and dissertations (Sylvia and Lesher 1995).

There has been less attention in the literature to sources used by undergraduate students. One study used papers from two universities and two liberal arts colleges and compared the format and age of materials used by students in different disciplines and at different undergraduate levels (Magrill and St. Clair 1990, St. Clair and Magrill 1992). Papers by senior psychology students at a large university and a small liberal arts college were analyzed in another study which found that about twenty journals accounted for 80% of the citations. The authors also found a wide diversity in the remaining titles cited at the two institutions, and they suggest that only local use studies are of practical value to libraries (Hardesty and Oltmanns 1989).

A study funded by the United States Office of Education measured information use by almost 2000 high school students in fifteen high schools. The report of this study is geared toward school library media specialists and presents survey data on the types of libraries used by these students and a citation analysis of the format and age of the

literature they cited in their papers. This report gives detailed information on the methodology of the study and includes copies of the questionnaire used and sample coding sheets for the citation analysis (Mancall and Drott 1983).

Citation Analysis Using Journals or Indexes

Some citation studies analyze citations in the standard or significant journals or indexes in a discipline to create core lists of journals or determine which journals have the greatest impact. Two studies in social work use this technique. One analyzes the citations in two national social work journals and the *Encyclopedia of Social Work* and compares this data with the citations by faculty in a school of social work (Wiberly 1982). A similar study uses citations from a current awareness bulletin and compares them to a local use study (Wilson 1994). A study at Purdue University compared citations in three interdisciplinary core history journals with the history collection in the Purdue University libraries (Herubel 1990). Political science collections in five Washington, D. C. area university libraries are evaluated using citations from a prestigious political science review journal and five political science journals (Nisonger 1983).

Use Patterns of Journals in Medical Libraries

This research project uses citation analysis to study the use patterns of medical journals by one group of hospital library patrons. This kind of information is of particular interest and importance to health sciences librarians, who need to know which resources are the most valuable or will receive the most use in their libraries.

It has been shown that researchers in medicine use a higher percentage of serials as opposed to monographs (Devin 1989). One study analyzed citations from ten highly ranked internal medicine journals and citations in two British and five American internal medicine textbooks. Data was also tabulated on the local use of monographs or serials by physicians, residents and students to answer questions or topics from hospital rounds. The researchers weighted the averages of the citations in the serials and textbooks to allow for different numbers of articles published, and found a ratio of 88% serial citations to 12% monograph citations. The ratio for serials to monographs used for the questions from hospital rounds was 89.5% serials to 10.5% monographs (Burdick, Butler and Sullivan 1993).

Core Lists

Standard core lists of recommended medical literature are available and are often consulted by health sciences librarians in developing and evaluating their collections. Two of the best known among medical librarians are the Brandon/Hill list, which covers medical, nursing and allied health monographs and journals, and the *Abridged Index Medicus* list of indexed periodicals. Core lists contain selected titles which are central to a field, and therefore most likely to be used. One researcher discusses and compares five core lists of medical journals - the Brandon/Hill list, the Moll list, the *Abridged Index Medicus* list, the Allyn list and the Bell list. The merged lists contain 450 titles. Thirty-seven titles were on all five lists, and thirty-four more titles were on four of the lists. The *AIM* list had the greatest agreement with the consensus and the smallest number of unique titles (Usdin 1979).

Journal Citation Reports, which is produced by the Institute for Scientific Information as a supplement to *Science Citation Index*, ranks journals by an "impact factor." ISI's impact factors are designed to allow valid comparisons of journals which publish different types and volumes of articles. An "immediacy index" records how quickly an article is cited after it is published. Garfield provides lists of general and internal medicine journals ranked by citations and by impact factor, and also a list of biomedical research journals ranked by impact factor (Garfield 1986).

Usdin matched the data from her core list comparisons to rankings from *Journal Citation Reports* and found results that were complex and difficult to explain. She recommends that *Journal Citation Reports* be used only in conjunction with other selection tools (Usdin 1979).

Analyses of indexes have been used in the medical field, as in other disciplines, to develop lists of core journals. This technique is particularly useful in fields which draw on a variety of disciplines. One study uses three indexes in the field of rehabilitation to develop a core list of journals (Bohannon and Roberts 1991). Another examines serial use in citations from journals abstracted in *Behavioral Medicine Abstracts*. The ninety-one resulting journal titles are compared with the Brandon/Hill list and the *Abridged Index Medicus* list. While 38% of the titles appeared on at least one of the lists, fifty-six heavily used titles do not appear on either list, an indication of the multidisciplinary nature of the field (Slater and Slater 1994).

Some studies of medical literature use emphasize the application of new technologies to the techniques of citation analysis. An analysis of citations on the topic "gait" describes in detail a technique involving CD-

ROM databases and a reprint management program to study key journals and databases (Burnham, Shearer and Wall 1992).

Use Studies in Medical Libraries

In addition to using the standard core lists to measure use of materials in medical libraries, researchers have designed local use studies of various types. Circulation statistics provide data on the use of items which circulate, but serials often do not circulate. Studies of interlibrary loan requests can show items not owned by the library which are being used by library patrons (Lacroix 1994). Local use studies of medical literature have been published in which data was gathered from reshelving counts, user self-reporting surveys and analyses of sources used to answer medical information questions. Most local use studies reported in the literature have used these techniques, rather than citation analysis.

A study at Himmelfarb Health Sciences Library at George Washington University used barcodes on all bound and unbound journals added to the library collection to measure in-house use. Before journals were reshelved, the barcodes were scanned into a computer and the resulting data was used to help make decisions on journal cancellations required by a strained budget. The researchers emphasize that other factors were taken into consideration including the frequency of publication, available indexing, and the library's holdings and binding patterns (Bader and Thompson 1989).

A reshelving study at the University of Minnesota Bio-Medical Library used samples from two different time periods. Lists of top ranked

journals used in the library are presented, along with data on the age of the journals used (Tibbetts 1974).

Another study analyzed data collected from reshelving counts, interlibrary loan requests, storage requests and journal reserves. The cost and space required for each journal (density of use) and other information on categories of use, use by different patron groups, year of publication, and subject was added. The objective of this complicated study was to learn the content, cost and space requirements of a collection that would fill all the demands of the library's users (Bastille and Mankin 1980).

A brief report on a study in the Brockton Hospital Library, Brockton, Massachusetts uses statistics on the age of journals used for photocopy requests, in-house reading and circulation of periodicals to evaluate policies for the retention of journals. Varied use patterns for different journals were reported by the author of the article, who recommends that decisions on length of retention of journals be made on an individual basis, rather than by a blanket policy (Kamenoff 1977). A similar study in a pediatric teaching hospital used circulation data, reshelving statistics and an analysis of interlibrary loan requests to measure journal use (Joan Smith 1970).

A study measuring a different type of use analyzed journals used by medical librarians to answer 144 patient-care related questions in the Library of Medicine at the Medical College of Pennsylvania. The 191 titles used to answer the questions were matched against the Brandon/Hill list. The researchers found that 36% of them were Brandon/Hill titles. A total of 904 articles were used to answer the questions. Only eighteen titles furnished 47.6% of the articles. Almost two-thirds of the articles

used had been published in the last five years, and most of the articles used that were older than five years came from core journals (Miller and Moore 1984).

Only one study was found which analyzed citations in papers of local medical researchers. A study of the references cited in publications by researchers at the Northeastern Ohio Universities College of Medicine is reported in a master's research paper. The researcher compared the journals cited to the library's holdings. Citations were collected from a "hand count" and from a DIALOG search in SciSearch. An important finding is that there are significant problems with the accuracy of citation data, with the coverage and accuracy of SciSearch, and with the citation analysis process. Readers are advised against using citation data alone to decide on the purchase or cancellation of journals (Hanrahan 1994).

Assumptions and Limitations of Citation Analysis

Researchers who interpret citation analysis data need to be aware of the assumptions that are implicit in this technique. Citation analysis assumes that authors refer to all the sources they used (or at least the most important ones), that they used all the documents they cite, that citing a document implies that it has some quality or merit, that authors cite the best works on their subjects, that there is a semantic relationship between a citing document and the cited document, and that all citations are equal (Linda Smith 1981). Citation studies are limited by the extent to which these assumptions are accurate for a given document.

Possible inaccuracies in data can involve differences in citing patterns in various fields, wide variations in citation counts from one

year to another, and errors in the citations included. Other inaccuracies result from the characteristics of citation indexing tools such as *Science Citation Index*. There are problems with selective indexing, with authority control of names, and with indexing when there are multiple authors (Linda Smith 1981).

Other researchers also highlight limitations of citation analysis and the cautions that should be observed in using it. Some writers point out that citations reflect only one type of use, and that other uses which are not reflected in citations need to be considered. Journals which are written and read for research purposes are more likely to be cited than those that focus on reviews, news or current awareness (Garfield 1972). Journals of an applied nature are cited much less frequently than research oriented journals (Scales 1976). Citation analysis often reflects the use of sophisticated scholars and their use should not be assumed to be the same as the use of undergraduates or other library patrons (Broadus 1977). Literature other than serials, such as textbooks, encyclopedias and other reference works are often heavily used, but not cited (Subramanyam 1980). Citation data may also be biased by what is available in a local collection. Articles cited may those that were readily available, rather than the best resources for the topic (Todorov 1988). Finally, caution is suggested in comparing literature from different disciplines, because citation practices vary, as does the rate of obsolescence in different fields (Stankus and Rice 1982), and small fields within a discipline are often under-represented in citation analyses (Archibald and Finifter 1987).

Uses of Citation Analysis

Citation analysis and other types of use studies are often employed by librarians, particularly in academic libraries, in conjunction with the standard core lists, to develop and evaluate local collections, "deselect" journal titles which are not used enough to justify their cost, and consign seldom-used materials to remote storage.

Researchers suggest the use of citation analysis or other local use studies to tailor serials collections to the needs of individual libraries (Greene 1993). Some recommend the use of *Journal Citation Reports* combined with a study of local use information and user surveys to aid in deselection of journals (Dombrowski 1988, Thomas Smith 1985). Others stress the value of local rather than generalized studies, along with the need to look at other factors such as uses per subscription cost and uses per foot of shelf space (Line and Sandison 1975, Line 1978).

Studies of the cited use of journal literature by local patron groups in libraries, when applied with caution and an awareness of the assumptions and limitations of the technique, can be a useful part of an on-going evaluation of the needs of library users.

III. METHODOLOGY

The source of citations used in this study was papers submitted to the annual Research Award Paper Competition by residents in thirteen accredited residency training programs at Summa Health System, an 811 bed, two-hospital health care facility in Akron, Ohio. All papers submitted in 1993, 1994 and 1995 were analyzed. Two papers, reports of experiments which contained no citations, were omitted. The remaining fifty-two papers contained 874 citations. Of these citations, only five were so incomplete that it was impossible to determine what source was being cited. These five citations were omitted, leaving a total of 869 citations for analysis.

The citations from the papers were analyzed to determine the format of the literature used (book, journal, conference report, etc.) and the age of the cited publication. Journal articles were further analyzed as to journal title, the frequency of citation to each journal title, the country of publication, language of the article, and whether the article was in a general medical journal or in a specialty journal, either in the field of the paper's author, or in another specialty field. This information was coded and entered into EDD, a data entry and modification system at Kent State University. The data was analyzed using SAS (Statistical Analysis System). All percentages were rounded to one decimal place. Appendix D is a copy of the coding sheet used to enter the data for each citation. Information on the age of the cited sources was coded in discrete categories to allow for easier analysis.

The list of journals cited by this group of residents was compared to the *Abridged Index Medicus List of Journals Indexed* and the Brandon/Hill list to see how these residents' use of literature correlates

with two lists of standard or core journals. Finally, the current journal subscription list of the two Summa libraries was checked to learn which of the cited journals were currently received.

IV. ANALYSIS OF DATA

The papers were written by residents in eleven of the thirteen accredited residency programs. There were many more papers in some specialties than others. Eleven of the fifty-two papers were written by residents in orthopedics, while there was only one paper each in ophthalmology and urology. Because of this extreme variation in the number of papers in different disciplines, no attempt was made to compare the citing patterns of residents in the various specialties.

The fifty-two papers analyzed contained a total of 869 usable citations. The number of citations per paper ranged from a low of three in one paper to a high of fifty-one in another paper.

Source Types of Citations

The citations were divided into seven source types: books, conference papers, unpublished works, personal communications, government documents, journal articles and "other." As expected, a vast majority of the citations, 793 or 91.3%, were to journal articles, a pattern consistent with the typical use of literature types in the hard sciences. This figure is comparable to the 85.2% reported by Devin for use of serial literature by medical researchers (Devin 1989) and the 88% and 89.5% reported by Burdick ((Burdick, Butler and Sullivan 1993). Books were cited in fifty-eight or 6.7% of the 869 references. The remaining eighteen citations were to sources of other types. Figure 1 shows this breakdown of source types. For a complete tabulation of citations to the seven types of sources, see Appendix A.

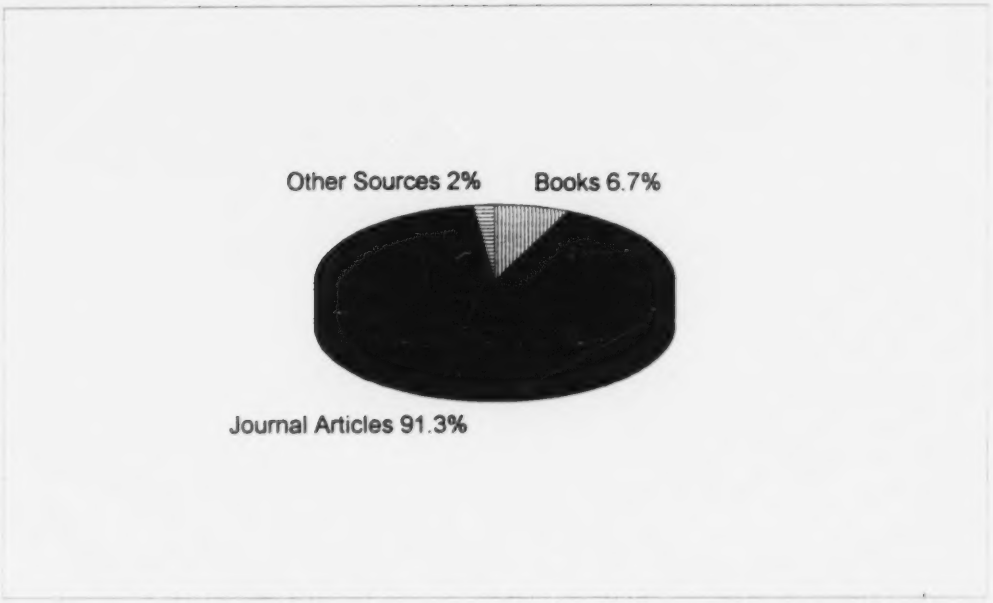

Figure 1. Source type of cited works

Age of Citations

The citations in the papers were also analyzed to determine the age of the sources used. It was expected that a high proportion of sources cited would be five years old or less. In fact, citations for the first five years totaled only 45.6% of the total, with 67.7% of the citations being to sources ten years old or less. Sources older than twenty years accounted for 14.4% of the total. Among the oldest articles cited were one from 1902 and two from 1912.

An interesting pattern emerged when the age of citations to books and to journal articles were looked at separately. Of the fifty-eight books cited in the papers, 69% were five years old or newer, while only 5.2% were over twenty years old. (See Figure 2) The data for citations to the 793 journal articles is shown in Figure 3. When journals were cited,

43.1% of the articles were five years old or newer, with 15.5% of the articles older than twenty years.

An explanation for this difference in citing patterns for books and journals may be that small and medium-sized libraries are far more likely to have older volumes of journals on the shelves than they are to have older editions of books. An older edition of a book is often discarded or put in storage when a new edition is added to the collection. In addition, perhaps older journal articles are traditionally seen in the hard sciences as more legitimate sources for historical background and literature review than are older books.

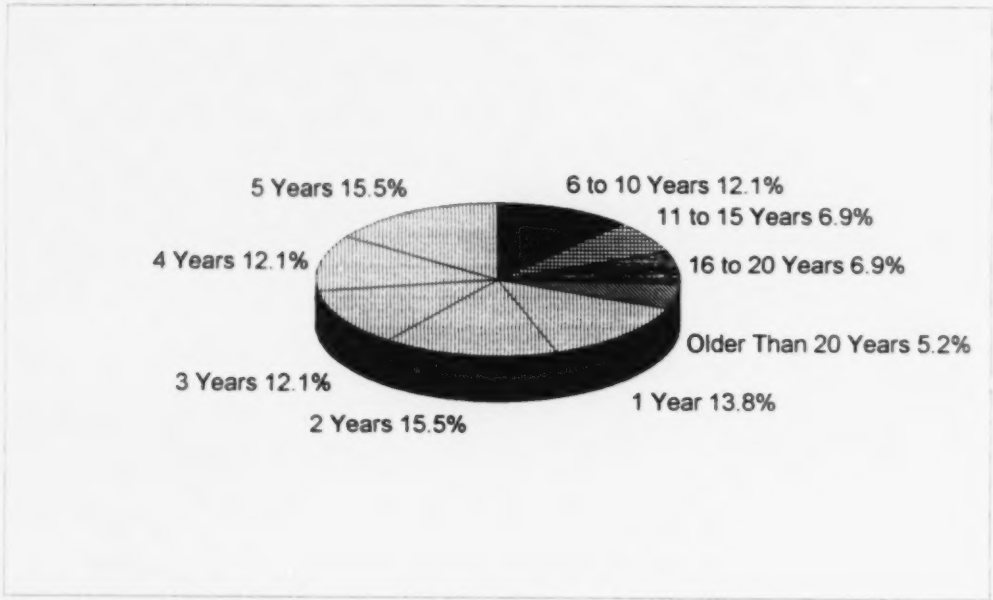

Figure 2. Age of cited books

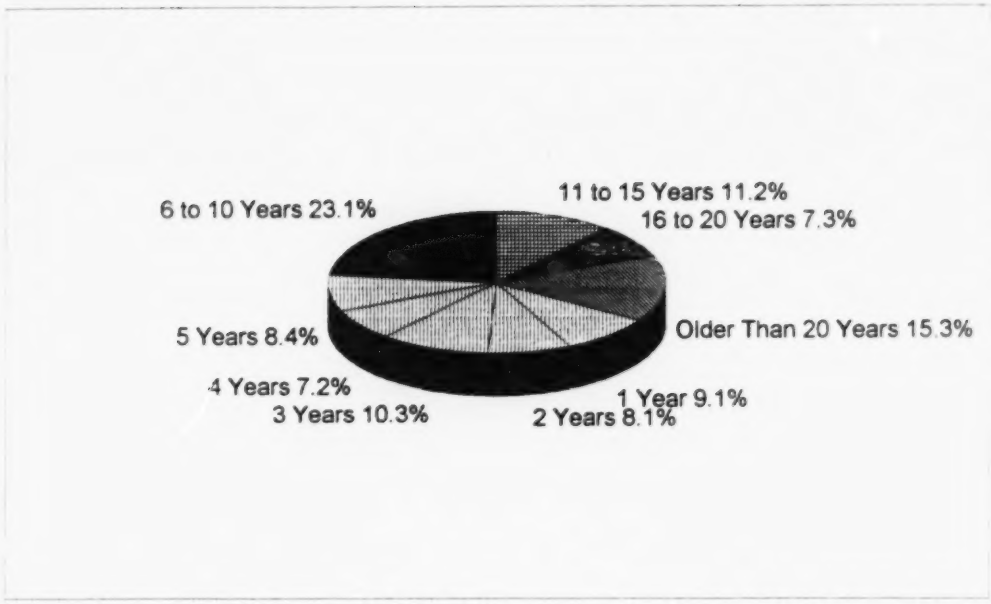

Figure 3. Age of cited journal articles

Journals Cited

A total of 252 different journal titles were cited in these papers. Citation frequency ranged from forty citations for *Clinical Orthopaedics and Related Research*, to one citation each for 129 journal titles. The top three journals, all in orthopedics, had over 10% of the total citations, a reflection of the high participation by orthopedic residents in the research paper competition. (Papers by orthopedic residents accounted for 25.4% of the total citations in the fifty-two papers). Appendix B includes a list of all the journals cited and the frequency and percentage of citations.

Bradford's law of scattering would predict that 20% of the titles, or about fifty journals on the list, should account for 80% of the citations. In fact, the top 20% of the cited journals account for only about 59% of the citations. Citations to nearly 43% of the journal titles must be

counted to reach the 80% level. At this point, more than half the journal titles which received only two citations are included. These figures indicate use of a much longer and more varied list of journals by these residents than might be predicted by bibliometric laws.

Country of Publication

The country of publication was also noted for each journal citation. Over 82% of the journals cited are published in the United States. An additional 11.3% are published in England, with the remaining 6.6% published in other countries. Figure 4 shows this distribution of countries of publication, with the complete tabulation by country of publication appearing in Appendix C.

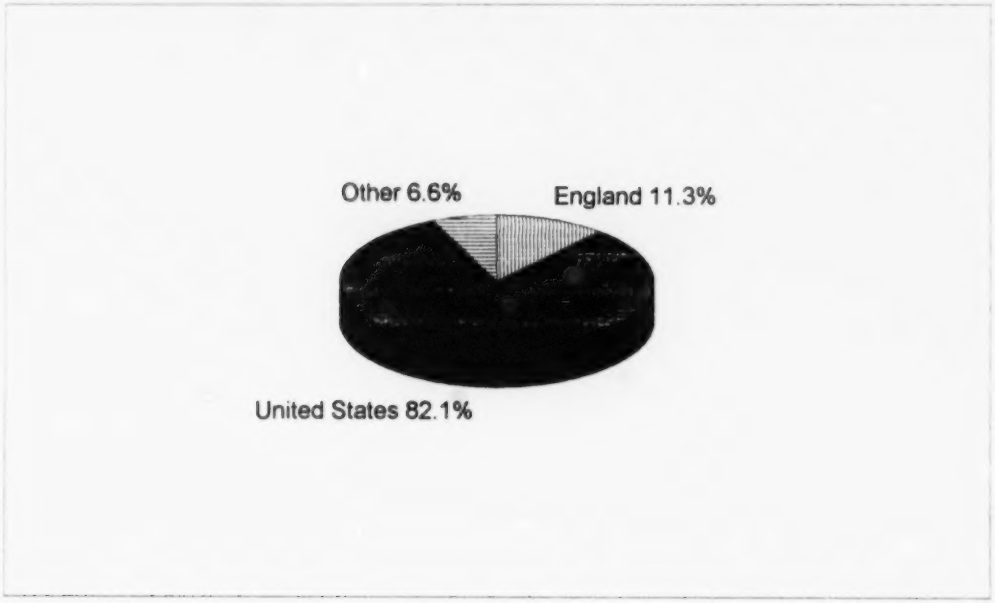

Figure 4. Country of publication of cited journals

Language of Journal Articles

All but two of the 793 journal articles were written in the English language, with one article in German and another in Portuguese. Journals were cited that are published in several countries where English is not the primary language, but most of these journals are published in English, or have an English language edition. Foreign language journals indexed in *Index Medicus* or *Medline* have an English language translation of the title, and usually an abstract in English. It is possible for researchers to use only the abstract to get some information from the indexed article, without having to read the original article. It is not known whether the entire article or just the abstract was used for the two cited foreign language articles.

Specialty of Journals Cited

The final characteristic of the citations which was studied was the specialty of the journals cited in relation to the specialty of the citing author. Figure 5 shows these relationships. General medical journals accounted for ninety-three or 11.7% of the journal article citations. The authors of the papers cited journals in their own specialty in 31.9% of the journal citations, and in other specialties in 54.5% of the citations. The "other" category includes scientific journals which are not specifically medical journals.

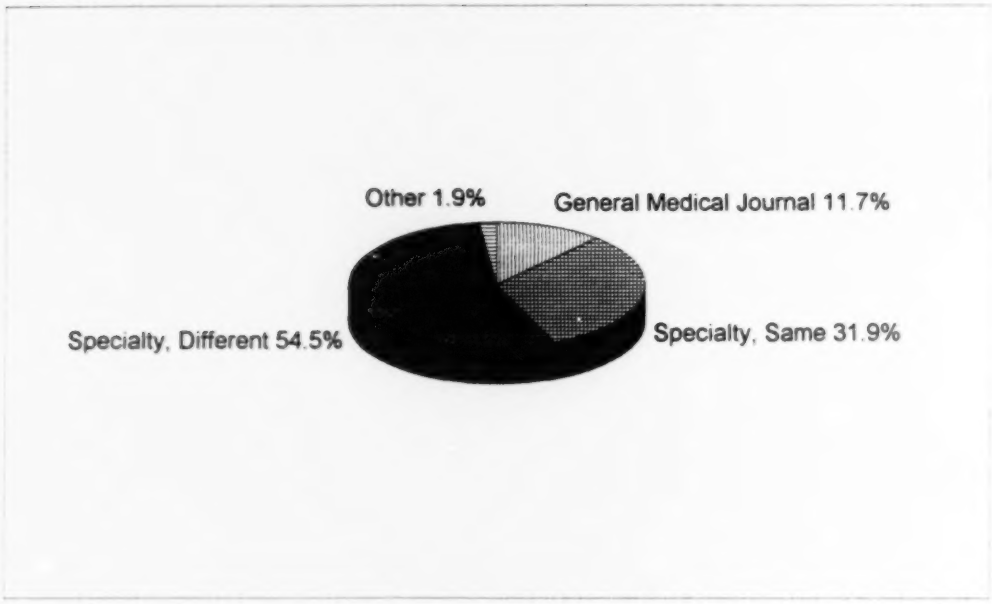

Figure 5. Specialty of journals cited: general medical journals, specialty journals in the same specialty as that of the author, and journals in specialties other than that of the author

Comparison of Journal Titles Cited with Core Lists and Subscriptions

The final element of analysis of the journal citations in these papers was a comparison of the journal titles cited with the *Abridged Index Medicus List of Journals Indexed*, the Brandon/Hill list, and the current subscription list of the Summa libraries. The thirteen journal titles with the highest number of citations, a total of 221 citations or almost 28% of the total citations in the papers, were listed on both core lists and also on the current subscription lists of the libraries. The percentage of cited titles that are on each of the core lists and on the subscription list is represented in Figure 6. Of the total list of 252 journal titles, seventy-three or 29% of them are on the *AIM* list. The Brandon/Hill list includes seventy-six or 30% of the 252 cited titles. The

current subscription list of the two libraries includes 109 or 43% of the cited titles.

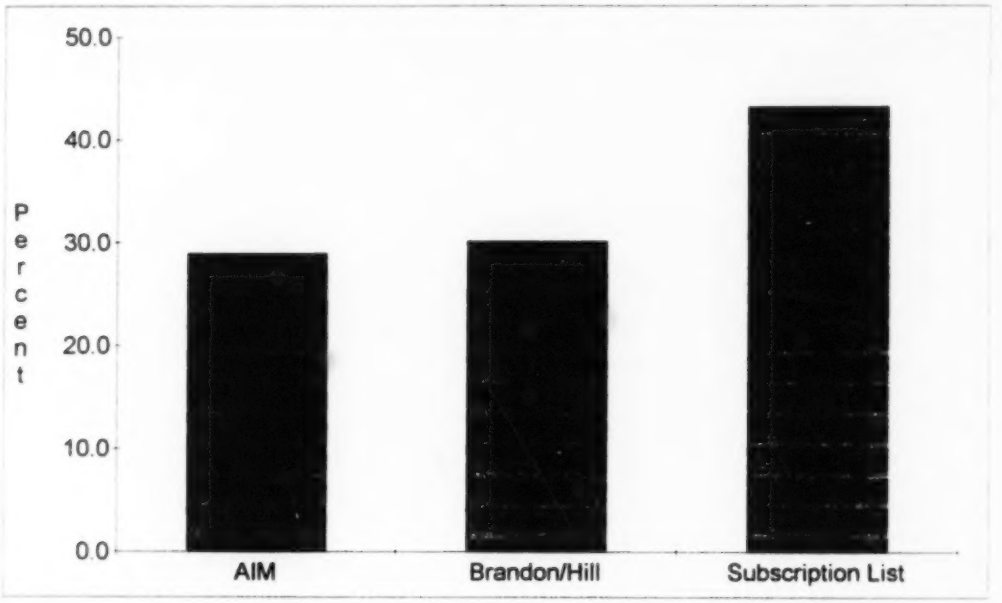

Figure 6. Percent of cited journal titles on core lists and subscription list

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V. SUMMARY AND CONCLUSIONS

This study presents a picture of the use of medical and scientific literature by a group of residents at Summa Health System who entered a research paper competition. The study showed a high use of journal articles as opposed to books and other source types, a finding that was expected in the medical field and consistent with other research.

The literature used by the residents was older than might have been expected given the usual bibliometric predictions on the rapid aging and obsolescence of literature in the hard sciences. Most papers, however, involved a review of the literature on the author's topic, leading to the citation of a large number of older articles.

There were 252 journal titles cited in the papers. The expected clustering of 80% of the citations in 20% of the articles did not occur. Citations were spread over a larger number of journal titles, representing a greater scattering of citations than predicted by bibliometric laws.

Because participation in the research paper competition is voluntary, the papers studied represent a self-selected sample of residents who chose to enter the competition. The number of residents in each residency program is different, with some programs being larger than others. The participation level in this competition by residents in some programs is also higher than in others. The study particularly reflects the strong research orientation of the Orthopedics Department, which recently opened a new musculoskeletal research laboratory. It is assumed that this emphasis on orthopedic research had an effect on the number of orthopedic papers and the number of citations to orthopedic journals. No comparisons were made of the use of literature by residents

in different residency training programs because the sample is not equally representative of all departments.

The country of publication of the cited journals reveals a very high use of journals published in the United States, and even when foreign journals are used, the articles are almost exclusively in the English language. Medicine in the United States is strongly oriented toward the western world, and this orientation is reflected in the indexing sources commonly used and the literature which is readily available.

While no comparative statistics were attempted because of the disproportionate number of papers and citations in the various specialties, it is interesting to note that authors in some specialties cited journals within their own specialty more than other authors did. Orthopedic residents tended to cite orthopedic literature almost exclusively, while residents in Emergency Medicine, Internal Medicine and Family Practice used the literature of other specialties more often. This is to be expected, given the multidisciplinary nature of the later specialties. There are also many more orthopedic journals published and indexed than, for example, internal medicine journals. The 1994 edition of *List of Journals Indexed in Index Medicus* lists forty-one journals in Orthopedics with seventeen of them published in the United States. Twenty-one Internal Medicine journals are listed, with only four of them published in the United States.

The comparison of the cited journals with the core lists shows a strong agreement between the *AIM* and Brandon/Hill lists. There were only seventeen differences between the two lists on the entire 252 journal titles. *AIM* listed 29% of the journal titles, while the Brandon/Hill list contained 30% of the titles.

The higher percentage of cited journal titles that are on the current subscription list of the Summa Libraries may be partly due to the tendency of library patrons to use literature which is easily available, but it also reflects the attention that has been paid in collection development to the needs and specialties of the particular patron groups served by the two libraries.

It is important to note that these papers represent one type of literature use - the writing of research papers by a self-selected group of authors. The sources cited for this purpose may very well be different from those which are used by the same residents for current awareness or clinical/patient care purposes. Their use of literature is also not generalizable to all residents at Summa. Residents who did not enter this competition are not represented at all by this data. They may very well use other sources for their research-oriented activities, current awareness and clinical information needs. Likewise, these results are not generalizable to literature use by residents at other institutions.

Finally, residents are only one part of the diverse health care community served by the Summa Libraries. Researchers, hospital-based and attending physicians, hospital administrators, faculty and administrators in medical and nursing education programs, nursing students, medical students, staff and students in a variety of laboratory and allied health fields, and other hospital employees are also served by the libraries. In addition, circuit library service is provided for a number of small hospitals and agencies in the area. The information needs and the literature used by this diverse group of library patrons have not been represented in this study.

This study of the sources used by residents in these papers, therefore, provides part of a picture of the information sources used by the hospital community. In order to use such information to make decisions on journal selection or deselection, it would be necessary to gather similar information for other groups served by the hospital libraries. Further research with a variety of types of use studies are needed to more completely describe literature use by the different patron groups for their diverse information needs.

This study highlights the importance of analyzing local use of literature sources, rather than relying solely on core lists and information derived from studies in other libraries. Each medical library serves a unique institution with its own programs, projects, and areas of specialization. The more information that can be gathered about the information needs of that institution and its diverse group of library patrons, the better able the library will be to provide efficient, cost-effective and high quality library service.

Appendix A

Source Types of Citations

Source Type	Frequency	Percent
Book	58	6.67
Conference Paper	4	0.46
Unpublished Work	4	0.46
Personal Communication	1	0.12
Government Document	8	0.92
Journal article	793	91.25
Other*	1	0.12

* This was a citation to a computer program.

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Appendix B

Journals Cited: Frequency, Percentages, Core Lists and Current Subscriptions

JOURNAL	# of Cit.	Percent	Cum. Freq. %	AIM	Brandon/Hill	Current Sub.
Clinical Orthopaedics and Related Research	40	5.04	5.04	X	X	X
Journal of Bone and Joint Surgery - American	27	3.40	8.45	X	X	X
Journal of Bone and Joint Surgery - British	18	2.27	10.72	X	X	X
JAMA	18	2.27	12.99	X	X	X
New England Journal of Medicine	17	2.14	15.13	X	X	X
Plastic and Reconstructive Surgery	16	2.02	17.15	X	X	X
Circulation	15	1.89	19.04	X	X	X
Cancer	13	1.64	20.68	X	X	X
American Journal of Obstetrics and Gynecology	12	1.51	22.19	X	X	X
Pediatrics	12	1.51	23.71	X	X	X
Annals of Emergency Medicine	11	1.39	25.09	X	X	X
Journal of the American College of Cardiology	11	1.39	26.48	X	X	X
Obstetrics and Gynecology	11	1.39	27.87	X	X	X
American Journal of Sports Medicine	10	1.26	29.13		X	X
BMJ	10	1.26	30.39	X	X	X
Journal of Reproductive Medicine	10	1.26	31.65			X
Journal of Urology	10	1.26	32.91	X	X	X
Journal of Vascular Surgery	10	1.26	34.17		X	X
Archives of Internal Medicine	9	1.13	35.31	X	X	X
Journal of Family Practice	9	1.13	36.44	X	X	X
Journal of Hand Surgery - American	9	1.13	37.58			X
Journal of Trauma	9	1.13	38.71	X	X	X
Lancet	9	1.13	39.85	X	X	X
Neurosurgery	9	1.13	40.98		X	
Acta Orthopaedica Scandinavica	8	1.01	41.99			X
AJR. American Journal of Roentgenology	8	1.01	43.00	X	X	X
American Journal of Clinical Pathology	7	0.88	43.88	X	X	X
American Journal of Surgical Pathology	7	0.88	44.77			X
Archives of Pathology and Laboratory Medicine	7	0.88	45.65	X	X	X

JOURNAL	# of Cit.	Percent	Cum. Freq. %	AIM	Brandon/Hill	Current Sub.
Journal of Neurosurgery	7	0.88	46.53	X	X	X
Radiology	7	0.88	47.41	X	X	X
American Journal of Pathology	6	0.76	48.17	X	X	X
Annals of Internal Medicine	6	0.76	48.93	X	X	X
Clinics in Plastic Surgery	6	0.76	49.68			X
Journal of Arthroplasty	6	0.76	50.44			
Orthopedic Clinics of North America	6	0.76	51.20	X	X	X
Acta Cytologica	5	0.63	51.83			
American Surgeon	5	0.63	52.46			X
Arthroscopy	5	0.63	53.09			X
Blood	5	0.63	53.72	X	X	X
British Journal of Surgery	5	0.63	54.35	X	X	X
Seminars in Diagnostic Pathology	5	0.63	54.98			
Spine	5	0.63	55.61			X
Surgery, Gynecology and Obstetrics	5	0.63	56.24			
Thorax	5	0.63	56.87			X
American Journal of Cardiology	4	0.50	57.38	X	X	X
American Journal of Diseases of Children	4	0.50	57.88			X
American Journal of Medicine	4	0.50	58.39	X	X	X
Annals of Thoracic Surgery	4	0.50	58.89	X	X	X
Archives of General Psychiatry	4	0.50	59.39	X	X	X
Chest	4	0.50	59.90	X	X	X
Circulation Research	4	0.50	60.40			X
Fertility and Sterility	4	0.50	60.91		X	X
Journal of Clinical Investigation	4	0.50	61.41	X	X	
Journal of Pediatrics	4	0.50	61.92			X
Orthopaedic Review	4	0.50	62.42	X	X	
Proceedings of the National Academy of Sciences	4	0.50	62.93			
Science	4	0.50	63.43			X
Southern Medical Journal	4	0.50	63.93	X		X
Surgical Clinics of North America	4	0.50	64.44	X	X	X
Surgery	4	0.50	64.94	X	X	X
Acta Chirurgica Scandinavica	3	0.38	65.32			
American Journal of Public Health	3	0.38	65.70	X	X	X
Archives of Surgery	3	0.38	66.08	X	X	X

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JOURNAL	# of Cit.	Percent	Cum. Freq. %	AIM	Brandon/Hill	Current Sub.
British Heart Journal	3	0.38	66.46	X		X
British Journal of Obstetrics and Gynaecology	3	0.38	66.83	X	X	X
Cancer Treatment Reports	3	0.38	67.21			X
Critical Care Medicine	3	0.38	67.59	X	X	X
Human Pathology	3	0.38	67.97			X
International Journal of Gynecological Pathology	3	0.38	68.35			
Journal of Abnormal Psychology	3	0.38	68.73			
Journal of the American Academy of Child and Adolescent Psychiatry	3	0.38	69.10			
Journal of Computer Assisted Tomography	3	0.38	69.48			
Journal of Developmental and Behavioral Pediatrics	3	0.38	69.86			
Journal of Foot and Ankle Surgery	3	0.38	70.24			
Journal of Histochemistry and Cytochemistry	3	0.38	70.62			
Journal of Pediatric Orthopedics	3	0.38	71.00			
Journal of Pediatric Surgery	3	0.38	71.37			
Journal of the Royal Society of Medicine	3	0.38	71.75			
Kidney International	3	0.38	72.13			
Mayo Clinic Proceedings	3	0.38	72.51	X		X
Medical Care	3	0.38	72.89			
Medical Clinics of North America	3	0.38	73.27	X	X	X
Physicians and Sports Medicine	3	0.38	73.64			X
Postgraduate Medical Journal	3	0.38	74.02			
Surgical Neurology	3	0.38	74.40			X
Acta Paediatrica Scandinavica	2	0.25	74.65			
Acta Radiologica	2	0.25	74.91			
American Heart Journal	2	0.25	75.16	X	X	X
American Journal of Human Genetics	2	0.25	75.41		X	
American Journal of Preventive Medicine	2	0.25	75.66			
Annals of Plastic Surgery	2	0.25	75.91			X
Annals of the Rheumatic Diseases	2	0.25	76.17			
British Journal of Plastic Surgery	2	0.25	76.42			X
British Journal of Radiology	2	0.25	76.67	X	X	X
Canadian Journal of Surgery	2	0.25	76.92			
Clinical Pediatrics	2	0.25	77.18	X	X	
Contributions to Nephrology	2	0.25	77.43			
European Journal of Radiology	2	0.25	77.68			

JOURNAL	# of Cit.	Percent	Cum. Freq. %	AIM	Brandon/Hill	Current Sub.
Family Medicine	2	0.25	77.93			
Geriatrics	2	0.25	78.18	X	X	X
Guy's Hospital Reports	2	0.25	78.44			
Gynecologic Oncology	2	0.25	78.69			X
Journal of Abnormal Child Psychology	2	0.25	78.94			
Journal of the American Podiatric Medical Association	2	0.25	79.19			
Journal of Biomedical Materials Research	2	0.25	79.45			
Journal of Cell Biology	2	0.25	79.70			
Journal of Consulting and Clinical Psychology	2	0.25	79.95			
Journal of General Internal Medicine	2	0.25	80.20			X
Journal of Sports Medicine and Physical Fitness	2	0.25	80.45			
Journal of Surgical Research	2	0.25	80.71			X
Laboratory Investigation	2	0.25	80.96			
Medicine and Science in Sports and Exercise	2	0.25	81.21			X
Microsurgery	2	0.25	81.46			X
MMWR. Morbidity and Mortality Weekly Report	2	0.25	81.72			X
Neurosurgery Clinics of North America	2	0.25	81.97			
Ophthalmology	2	0.25	82.22			X
Pediatric Clinics of North America	2	0.25	82.47	X	X	
Pediatric Emergency Care	2	0.25	82.72			
Pediatric Radiology	2	0.25	82.98			
Postgraduate Medicine	2	0.25	83.23	X	X	X
Preventive Medicine	2	0.25	83.48			
Vascular Surgery	2	0.25	83.73			X
Acta Medica Scandinavica	1	0.13	83.86			
Acta Orthopaedica Belgica	1	0.13	83.98			
Advances in Surgery	1	0.13	84.11			X
Age and Ageing	1	0.13	84.24			
AIDS	1	0.13	84.36			
American Family Physician	1	0.13	84.49	X	X	X
American Journal of Cardiovascular Pharmacology	1	0.13	84.62			
American Journal of Clinical Nutrition	1	0.13	84.74	X	X	X
American Journal of Emergency Medicine	1	0.13	84.87		X	
American Journal of Epidemiology	1	0.13	84.99			
American Journal of Medical Genetics	1	0.13	85.12			

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JOURNAL	# of Cit.	Percent	Cum. Freq. %	AIM	Brandon/Hill	Current Sub.
American Journal of Orthopsychiatry	1	0.13	85.25			
American Journal of Pediatric Hematology/Oncology	1	0.13	85.37			
American Journal of Physiology	1	0.13	85.50			
American Journal of Surgery	1	0.13	85.62	X	X	X
Anatomical Record	1	0.13	85.75			
Angiology	1	0.13	85.88		X	X
Annales Chirurgiae et Gynaecologiae	1	0.13	86.00			
Annals of the New York Academy of Sciences	1	0.13	86.13			
Annals of Otology, Rhinology and Laryngology	1	0.13	86.25	X		
Annals of Surgery	1	0.13	86.38	X	X	X
Archivum Chirurgicum Neerlandicum	1	0.13	86.51			
Archives of Disease in Childhood	1	0.13	86.63	X		
Archives of Ophthalmology	1	0.13	86.76	X	X	X
Archives of Orthopedic and Trauma Surgery	1	0.13	86.89			
Archives of Otolaryngology	1	0.13	87.01	X	X	X
Archives of Pathology	1	0.13	87.14			
Arquives de Cirurgia Clinica e Experimental	1	0.13	87.26			
Arteriosclerosis and Thrombosis	1	0.13	87.39			
Arthritis and Rheumatism	1	0.13	87.52	X		X
ASM News	1	0.13	87.64			
Australian and New Zealand Journal of Medicine	1	0.13	87.77			
Biochemical and Biophysical Research Communications	1	0.13	87.89			
British Journal of Anaesthesia	1	0.13	88.02			X
British Journal of Ophthalmology	1	0.13	88.15			
British Journal of Psychiatry	1	0.13	88.27			
Bulletin of the New York Academy of Medicine	1	0.13	88.40			X
California Medicine	1	0.13	88.52			
Canadian Journal of Cardiology	1	0.13	88.65			
Cancer Research	1	0.13	88.78			X
Cardiology Clinics	1	0.13	88.90			X
Child Development	1	0.13	89.03			
Chinese Medical Journal	1	0.13	89.16			
Cleft Palate - Craniofacial Journal	1	0.13	89.28			
Cleveland Clinic Journal of Medicine	1	0.13	89.41			X
Clinical Biomechanics	1	0.13	89.53			

JOURNAL	# of Cit.	Percent	Cum. Freq. %	AIM	Brandon/Hill	Current Sub.
Clinical Chemistry	1	0.13	89.66			
Clinical Endocrinology and Metabolism	1	0.13	89.79		X	
Clinical and Experimental Immunology	1	0.13	89.91			
Clnical Genetics	1	0.13	90.04			
Clinical Obstetrics and Gynecology	1	0.13	90.16		X	X
Clinical Immunology and Immunopathology	1	0.13	90.29			
Clinics in Podiatric Medicine and Surgery	1	0.13	90.42			
CMAJ. Canadian Medical Association Journal	1	0.13	90.54	X	X	X
Computerized Radiology	1	0.13	90.67			
Contemporary Urology	1	0.13	90.79			
Critical Care Clinics	1	0.13	90.92			
Current Problems in Surgery	1	0.13	91.05	X		
Emergency Medicine Clinics of North America	1	0.13	91.17		X	X
European Heart Journal	1	0.13	91.30			
European Journal of Surgical Oncology	1	0.13	91.42			
European Journal of Vascular Surgery	1	0.13	91.55			
Family Practice Research Journal	1	0.13	91.68			
Gastroenterology	1	0.13	91.80	X	X	X
Hand Clinics	1	0.13	91.93			
Health Services and Mental Health Administration Health Reports	1	0.13	92.06			
Hematological Oncology	1	0.13	92.18			
Human Genetics	1	0.13	92.31			
Injury	1	0.13	92.43			
International Angiology	1	0.13	92.56			
International Journal of Epidemiology	1	0.13	92.69			
International Surgery	1	0.13	92.81			
Journal of the American Dietetic Association	1	0.13	92.94	X	X	X
Journal of Applied Physiology	1	0.13	93.06			
Journal of the Arkansas Medical Society	1	0.13	93.19			
Journal Belge de Radiologie	1	0.13	93.32			
Journal of Cardiac Surgery	1	0.13	93.44			
Journal of Clinical Epidemiology	1	0.13	93.57			
Journal of Clinical Pathology	1	0.13	93.69	X	X	
Journal of Clinical Ultrasound	1	0.13	93.82			
Journal of Cranio-Axillo-Facial Surgery	1	0.13	93.95			

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JOURNAL	# of Cit.	Percent	Cum. Freq. %	AIM	Brandon/Hill	Current Sub.
Journal of Emergency Medicine	1	0.13	94.07			
Journal of Experimental Medicine	1	0.13	94.20			
Journal of Forensic Science	1	0.13	94.33			
Journal of Laryngology and Otology	1	0.13	94.45	X	X	
Journal of Medical Genetics	1	0.13	94.58			
Journal of Nervous and Mental Disease	1	0.13	94.70	X	X	X
Journal of Neurosurgical Sciences	1	0.13	94.83			
Journal of Obstetrics and Gynaecology of the British Empire	1	0.13	94.96			
Journal of Orthopaedic Research	1	0.13	95.08			
Journal of Orthopaedic and Sports Physical Therapy	1	0.13	95.21			
Journal of Pathology	1	0.13	95.33			
Journal of the Royal College of Surgeons of Edinburgh	1	0.13	95.46			
Journal of Rheumatology	1	0.13	95.59			X
Journal of Thoracic and Cardiovascular Surgery	1	0.13	95.71	X	X	X
Journal of Ultrasound in Medicine	1	0.13	95.84			
Laboratory Management	1	0.13	95.96			
Laboratory Medicine	1	0.13	96.09			
Laryngoscope	1	0.13	96.22			X
Medicine	1	0.13	96.34	X	X	X
Monographs of the Society for Research in Child Development	1	0.13	96.47			
Monthly Vital Statistics	1	0.13	96.60			
Mount Sinai Journal of Medicine	1	0.13	96.72			
Nagoya Medical Journal	1	0.13	96.85			
New York State Journal of Medicine	1	0.13	96.97			
Nature	1	0.13	97.10			
Netherlands Journal of Surgery	1	0.13	97.23			
Neuro-Chirurgie	1	0.13	97.35			
Neurology	1	0.13	97.48	X	X	X
Neuroscience	1	0.13	97.60			
Obstetrics and Gynecology Clinics of North America	1	0.13	97.73	X	X	X
Obstetric and Gynecological Survey	1	0.13	97.86			X
Pediatric Nephrology	1	0.13	97.98			
Pediatric Pathology	1	0.13	98.11			
Progress in Cardiovascular Diseases	1	0.13	98.23	X	X	X
Progress in Orthopaedic Surgery	1	0.13	98.36			

JOURNAL	# of Cit.	Percent	Cum. Freq. %	AIM	Brandon/Hill	Current Sub.
Patient Education and Counseling	1	0.13	98.49			X
Radiation Medicine	1	0.13	98.61			
Seminars in Veterinary Medicine and Surgery	1	0.13	98.74			
Skeletal Radiology	1	0.13	98.87			
Surgery Annual	1	0.13	98.99			
Surgical Forum	1	0.13	99.12			
Transplantation Proceedings	1	0.13	99.24			X
Turkish Journal of Pediatrics	1	0.13	99.37			
Urologic Radiology	1	0.13	99.50			
Urology	1	0.13	99.62			X
Vital Health Statistics	1	0.13	99.75			
Wounds	1	0.13	99.87			
Zentralblatt fur Chirurgie	1	0.13	100.00			

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Appendix C

Country of Publication of Cited Journals

Country	Frequency	Percent
Australia	1	0.1
Belgium	2	0.3
Brazil	1	0.1
Canada	5	0.6
China	1	0.1
Denmark	11	1.4
England	90	11.3
Finland	1	0.1
France	1	0.1
Germany	8	1.0
Ireland	2	0.3
Italy	5	0.6
Japan	2	0.3
Netherlands	2	0.3
Norway	2	0.3
Scotland	1	0.1
Sweden	4	0.5
Switzerland	2	0.3
Turkey	1	0.1
United States	651	82.1

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Appendix D

Coding Sheet

1. Paper # (2 digits)
2. Citation # (2 digits)

3. Source type

   _1_ Book (including handbooks)
   _2_ Encyclopedia, dictionary
   _3_ Conference paper, paper presented at meeting
   _4_ Unpublished work
   _5_ Personal communication
   _6_ Government document
   _7_ Journal (including annual reviews, annuals and proceedings that are published monthly, quarterly or annually as serials)
   _8_ Other

4. Age of cited work (see separate sheet with date ranges given for each of the three years of papers)

   _1_ Year of paper (year of paper and previous calendar year)
   _2_ Within 2nd calendar year before paper
   _3_ Within 3rd calendar year before paper
   _4_ Within 4th calendar year before paper
   _5_ Within 5th calendar year before paper
   _6_ Within 6th to 10th calendar year before paper
   _7_ Within 11th to 15th calendar year before paper
   _8_ Within 16th to 20th calendar year before paper
   _9_ 21st year before paper or older

If source type is journal (7), continue. Otherwise stop here.

5. Journal title (abbreviation from Index Medicus or other standardized format)

6. Country of publication

01 Australia	07 Finland	13 Netherlands
02 Belgium	08 France	14 Norway
03 Canada	09 Germany	15 Scotland
04 China	10 Ireland	16 Sweden
05 Denmark	11 Italy	17 Switzerland
06 England	12 Japan	18 Turkey
		19 United States
		20 Brazil

7. Language

_1_ English	_3_ Chinese	_5_ Italian
_2_ German	_4_ French	_6_ Japanese
		_7_ Portugese

8. Journal subject

   _1_ Medicine (general medical journals are grouped here)
   _2_ Specialty, same as author of citing author
   _3_ Specialty, other than specialty of citing author
   _4_ Other

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